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PLANETARY PHENOMENA FOR NOVEMBER AND DECEMBER, 1914.

By Malcolm McNeill.

PHASES OF THE MOON, PACIFIC TIME.

Full Moon	Nov. 2,	$3^h 49^m$ P.M.	Full Moon	Dec. 2,	$10^h 21^m$ A.M.
Last Quarter	" 10,	3 37 P.M.	Last Quarter	" 10,	3 32 A.M.
New Moon	" 17,	8 2 A.M.	New Moon	" 16,	6 35 P.M.
First Quarter	" 24,	5 39 A.M.	First Quarter	" 24,	12 25 A.M.

The Sun reaches the solstice and begins again its northward journey among the stars December 22d at about 8 A. M. Pacific time.

Mercury will be in transit across the Sun's disc on the morning of November 7th. Transits of *Mercury*, while not frequent, are much more so than transits of *Venus*, there being twelve in the present century. As they must occur when *Mercury* is near one of its nodes and the Earth also near the line of *Mercury's* nodes, there are two periods each year, early May and early November, during which all transits must occur. Also on account of the eccentricity of the planet's orbit November transits are more than twice as numerous as May transits. After a November transit another is possible in seven years, probable in thirteen years and practically certain in forty-six years. The present one is an instance of the first, there having been a November transit in 1907. Only the latter part of the present transit can be seen in this country, and in some parts none of it, the ingress taking place before sunrise. The principal circumstances are as follows, Pacific time:—

Ingress exterior contact	Nov. 7,	$1^h 57^m 14^s$ A.M.
Ingress interior contact	" 7,	1 59 27 A.M.
Least distance of centers 10′ 31″	" 7,	4 3 20 A.M.
Egress interior contact	" 7,	6 7 17 A.M.
Egress exterior contact	" 7,	6 9 31 A.M.

It will thus be seen that in the far west the entire transit is over before sunrise, but that the latter part of it may be observed in the central and eastern parts of the United States. A telescope is necessary to show the planet on the disc of the Sun.

After the transit, which occurs at the time of inferior conjunction, *Mercury* becomes a morning star and moves out toward greatest west elongation, reaching this position on November 23d. Before the middle of the month it will rise more than an hour before the Sun, and the interval will not be less than an hour until nearly the middle of December. About the time of greatest elongation the interval will be more than an hour and a half. There will therefore be a month when the planet can be seen in the morning twilight. It will be in close conjunction with *Venus* on the morning of December 7th, the nearest approach being about two thirds the diameter of the Moon, *Mercury* being north of *Venus.* At the end of the month *Mercury* has nearly reached superior conjunction with the Sun.

Venus is still an evening star on November 1st, but sets about an hour and a quarter after sunset. On November 27th it passes inferior conjunction with the Sun, becoming a morning star. On account of the fact that the planet is moving northward among the stars much more rapidly than the Sun is, the interval between the rising of the planet and of the Sun will increase very rapidly. By the middle of December the planet will rise more than two hours before sunrise, and there will be an additional increase of an hour by the end of the month. *Venus* will remain a morning star until September 12, 1915. After conjunction its brightness increases very rapidly and by the end of December it has nearly reached its maximum. This occurs January 2, 1915.

Mars is too near the Sun during November and December for naked-eye view. On November 1st it sets only forty minutes after sunset, and this interval continually diminishes until the planet reaches conjunction with the Sun at 9 P. M. Pacific time on December 23d. It then becomes a morning star and remains such until the next opposition. This does not occur until February 9, 1916. The interval from opposition on January 5, 1913, to conjunction is only 352 days, while from conjunction to the next opposition will be 413 days.

These intervals would be equal if the orbits of Earth and *Mars* were both circular. It is an unusual occurrence that an opposition and a conjunction occur in the same calendar year and neither in the year following. The average interval from opposition to conjunction is 390 days, nearly one year and one month.

Jupiter is in good position for evening observation in the southwestern sky. On November 1st it sets a little before half-past eleven and at the end of December shortly after 8 P. M. It is in the eastern part of the constellation *Capricorn* and moves about 9° eastward and 3° northward among the stars during the two months. It is in close conjunction with the Moon on the night of November 22d-23d and again on the evening of December 20th. It will be occulted on the latter date for some regions of the Earth.

Saturn is in good position for evening observation during the latter part of the two months' period. On November 1st it rises shortly after 8 P. M. and a little before sunset at the end of December. It comes to opposition with the Sun on the night of December 20th-21st. It is on the border-line between *Taurus* and *Gemini* and moves somewhat more than 4° westward during November and December. The appearance of the rings remains practically unchanged.

Uranus is in the southwestern sky in the evening, setting shortly before eleven on November 1st and shortly after seven on December 31st. It is in the constellation *Capricorn* and moves about 2° eastward. It lies to the west of *Jupiter* about 6° on November 1st, but this distance is nearly doubled by the end of December.

Neptune rises shortly after 10 P. M. November 1st, and shortly after 6 P. M. on December 31st. It is near the border-line of the constellations *Gemini* and *Cancer* and moves about 1° westward.